WHAT IS CLAIMED IS:

1. A method of embedding digital watermark information $b_1 - b_n$ ($2 \leq n$) in image data, comprising steps of:

dividing the image data into a plurality of areas S each consisting of $M \times N$ ($1 \leq M$, N) pixels;

defining a plurality of areas G each consisting of P $\times$ Q ($1 \leq P$, Q) of the areas S;

allocating each of the areas S constituting each area G to some one of: areas $T_1 - T_n$ in which said digital watermark information $b_1 - b_n$ is respectively embedded and areas $H_1 - H_m$ ($1 \leq m$) in which information is not embedded;

locating one or more areas T and one or more areas H in a predetermined arrangement in each area G; and

locating the plurality of areas G in a predetermined rule.

2. A method of embedding digital watermark information $b_1 - b_n$ ($2 \leq n$) in image data, comprising steps of:

dividing the image data into a plurality of areas S each consisting of $M \times N$ ($1 \leq M$, N) pixels;

defining a plurality of areas G each consisting of P $\times$ Q ($1 \leq P$, Q) of the areas S;

allocating each of the areas S constituting each area G to some one of: areas $T_1 - T_n$ in which said digital watermark information $b_1 - b_n$ is respectively embedded,

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10 areas J_1 - J_k $(1 \leq k)$ in which information p_1 - p_k $(1 \leq k)$

11 specifying an embedding format for embedding said digital

12 watermark information b_1 - b_n in said areas T_1 - T_n, and

13 areas H_1 - H_m $(1 \leq m)$ in which information is not embedded;

14   locating one or more areas T, one or more areas J,

15 one or more areas H in a predetermined arrangement in each

16 area G; and

17   locating the plurality of areas G in a predetermined

18 rule.

1 3.   The method of embedding digital watermark

2 information according to Claim 2, wherein:

3   said digital watermark information b_1 - b_n is

4 embedded by increasing or decreasing pixel data values in

5 the corresponding areas T_1 - T_n according to a bit value (0,

6 1) of each bit of the digital watermark information b_1 - b_n;

7 and

8   said information p_1 - p_k specifying said embedding

9 format is embedded such that said information indicates a

10 pattern of respective increasing/decreasing directions in

11 the area T_1 - T_n for a bit value of the digital watermark

12 information, in each area G to which the areas J_1 - J_k

13 embedded with said information p_1 - p_k belong.

1 4.   The method of embedding digital watermark

2 information according to Claim 1, wherein:

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3   each of said areas G includes a plurality of said

4   areas H that have been allocated so as to be asymmetric in

5   vertical and horizontal directions in the area G in

6   question.

1   5.   A method of extracting digital watermark

2   information, for extracting the digital watermark

3   information $b_1 - b_n$ ($2 \leq n$) from image data in which said

4   digital watermark information is embedded, comprising steps

5   of:

6   dividing the image data into a plurality of areas S

7   each consisting of M × N ($1 \leq$ M, N) pixels;

8   detecting areas $H_1 - H_m$ ($1 \leq m$) in which information

9   is not embedded, from said plurality of areas S; and

10   recognizing a plurality of areas G each consisting

11   of P × Q ($1 \leq$ P, Q) of the areas S, said plurality of areas

12   G being located on said image data, and said recognition

13   being carried out based on locations of said detected areas

14    $H_1 - H_m$ ($1 \leq m$) on said image data.

1   6.   A method of extracting digital watermark

2   information, for extracting the digital watermark

3   information $b_1 - b_n$ ($2 \leq n$) from image data in which said

4   digital watermark information is embedded, comprising steps

5   of:

6   dividing the image data into a plurality of areas S

7 each consisting of M × N (1 ≤ M, N) pixels;

8 detecting areas H_1 - H_m (1 ≤ m) in which information

9 is not embedded, from said plurality of areas S;

10 recognizing a plurality of areas G each consisting

11 of P × Q (1 ≤ P, Q) of the areas S, said plurality of areas

12 G being located on said image data, and said recognition

13 being carried out based on locations of said detected areas

14 H_1 - H_m (1 ≤ m) on said image data;

15 in each of the plurality of areas G recognized,

16 extracting information p_1 - p_k (1 ≤ k) from areas J_1 - J_k in

17 which said information p_1 - p_k (1 ≤ k) should be embedded,

18 said information p_1 - p_k specifying an embedding format for

19 embedding said digital watermark information b_1 - b_n

20 respectively in said areas T_1 - T_n;

21 recognizing the embedding format of the digital

22 watermark information b_1 - b_n in the areas T_1 - T_n in the

23 area G in question; and

24 extracting the digital watermark information b_1 - b_n

25 from the areas T_1 - T_n, according to the recognized

26 embedding format.

1 7. The method of extracting digital watermark

2 information according to Claim 6, wherein:

3 for each of the plurality of groups G recognized,

4 the information p_1 - p_k embedded in the areas J_1 - J_k is

5 extracted to recognize a pattern of increasing/decreasing

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6   directions of pixel data values for a bit value of the

7   digital watermark information, in the area G in question;

8   and

9   each bit value of the digital watermark information

10   b_1 - b_n embedded in the areas T_1 - T_n is detected according

11   to the recognized pattern of increasing/decreasing

12   directions.

1   8.   The method of extracting digital watermark

2   information according to Claim 5, wherein:

3   a plurality of areas H are detected from each of the

4   areas G;

5   the detected areas H are compared with an embedding

6   pattern for the areas H, said embedding pattern being

7   determined in advance such that the areas H become

8   asymmetric in vertical and horizontal directions in the

9   area G in question; and

10   contents of image processing carried out on the

11   image data are judged.

1   9.   A program product for making a computer execute a

2   method of embedding digital watermark information b_1 - b_n (2

3   ≤ n) in image data, comprising:

4   codes for dividing the image data into a plurality

5   of areas S each consisting of M × N (1 ≤ M, N) pixels;

6   codes for defining a plurality of areas G each

7 consisting of P × Q ($1 \leq$ P, Q) of the areas S;

8 codes for allocating each of the area S constituting

9 each area G to some one of: areas T_1 - T_n in which said

10 digital watermark information b_1 - b_n is respectively

11 embedded and areas H_1 - H_m ($1 \leq$ m) in which information is

12 not embedded;

13 codes for locating one or more areas T and one or

14 more areas H in a predetermined arrangement in each area G;

15 codes for locating the plurality of areas G in a

16 predetermined rule; and

17 a computer readable storage medium for holding the

18 codes.

1 10. A program product for making a computer execute a

2 method of embedding digital watermark information b_1 - b_n (2

3 $\leq$ n) in image data, comprising:

4 codes for dividing the image data into a plurality

5 of areas S each consisting of M × N ($1 \leq$ M, N) pixels;

6 codes for defining a plurality of areas G each

7 consisting of P × Q ($1 \leq$ P, Q) of the areas S;

8 codes for allocating each of the areas S

9 constituting each area G to some one of: areas T_1 - T_n in

10 which said digital watermark information b_1 - b_n is

11 respectively embedded, areas J_1 - J_k ($1 \leq$ k) in which

12 information p_1 - p_k ($1 \leq$ k) specifying an embedding format

13 for embedding said digital watermark information b_1 - b_n in

14   said areas T_1 - T_n, and areas H_1 - H_m $(1 \leq m)$ in which

15   information is not embedded;

16   codes for locating one or more areas T, one or more

17   areas J, and one or more areas H in a predetermined

18   arrangement in each area G;

19   codes for locating the plurality of areas G in a

20   predetermined rule; and

21   a computer readable storage medium for holding the

22   codes.

1   11.   The program product according to Claim 10, further

2   comprising:

3   codes for embedding said digital watermark

4   information b_1 - b_n by increasing or decreasing pixel data

5   values in the corresponding areas T_1 - T_n according to a bit

6   value (0, 1) of each bit of the digital watermark

7   information b_1 - b_n; and

8   codes for embedding said information p_1 - p_k

9   specifying said embedding format such that said information

10   indicates a pattern of respective increasing/decreasing

11   directions in the areas T_1 - T_n for a bit value of the

12   digital watermark information, in each area G to which the

13   areas J_1 - J_k embedded with said information p_1 - p_k belong.

1   12.   The program product according to Claim 9, wherein:

2   each of said areas G includes a plurality of said

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3   areas H that have been allocated so as to be asymmetric in

4   vertical and horizontal directions in the area G in

5   question.

1   13.   A program product for making a computer execute a

2   method of extracting digital watermark information b_1 - b_n

3    $(2 \leq n)$ from image data in which said digital watermark

4   information is embedded, comprising:

5   codes for dividing the image data into a plurality

6   of areas S each consisting of M × N $(1 \leq M, N)$ pixels;

7   codes for detecting areas H_1 - H_m $(1 \leq m)$ in which

8   information is not embedded, from said plurality of areas

9   S;

10   codes for recognizing a plurality of areas G each

11   consisting of P × Q $(1 \leq P, Q)$ of the areas S, said

12   plurality of areas G being located on said image data, and

13   said recognition being carried out based on locations of

14   said detected areas H_1 - H_m $(1 \leq m)$ on said image data; and

15   a computer readable storage medium for holding the

16   codes.

1   14.   A program product for making a computer execute a

2   method of extracting digital watermark information b_1 - b_n

3    $(2 \leq n)$ from image data in which said digital watermark

4   information is embedded, comprising:

5   codes for dividing the image data into a plurality

6   of areas S each consisting of M × N (1 ≤ M, N) pixels;

7   codes for detecting areas H_1 - H_m (1 ≤ m) in which

8   information is not embedded, from said plurality of areas

9   S;

10   codes for recognizing a plurality of areas G each

11   consisting of P × Q (1 ≤ P, Q) of the areas S, said

12   plurality of areas G being located on said image data, and

13   said recognition being carried out based on locations of

14   said detected areas H_1 - H_m (1 ≤ m) on said image data;

15   codes for extracting, in each of the plurality of

16   areas G recognized, information p_1 - p_k (1 ≤ k) from areas

17   J_1 - J_k in which said information p_1 - p_k (1 ≤ k) should be

18   embedded, said information p_1 - p_k specifying an embedding

19   format for embedding said digital watermark information b_1

20   - b_n respectively in said areas T_1 - T_n;

21   codes for recognizing the embedding format of the

22   digital watermark information b_1 - b_n in the areas T_1 - T_n

23   in the area G in question;

24   codes for extracting the digital watermark

25   information b_1 - b_n from the areas T_1 - T_n, according to the

26   recognized embedding format; and

27   a computer readable storage medium for holding the

28   codes.

1   15.   The program product according to Claim 14, further

2   comprising:

3   codes for extracting, for each of the plurality of

4   groups G recognized, the information p_1 - p_k embedded in the

5   areas J_1 - J_k, to recognize a pattern of

6   increasing/decreasing directions of pixel data values for a

7   bit value of the digital watermark information, in the area

8   G in question, and to detect each bit value of the digital

9   watermark information b_1 - b_n embedded in the areas T_1 - T_n

10   according to the recognized pattern of

11   increasing/decreasing directions.

1   16.   The program product according to Claim 13, further

2   comprising:

3   codes for detecting a plurality of areas H from each

4   of the areas G;

5   codes for comparing the detected areas H with an

6   embedding pattern for the areas H, said embedding pattern

7   being determined in advance such that the areas H become

8   asymmetric in vertical and horizontal directions in the

9   area G in question; and

10   codes for judging contents of image processing

11   carried out on the image data.

1   17.   An apparatus for embedding digital watermark

2   information b_1 - b_n ($2 \le n$) in image data, comprising:

3   a processing part for dividing the image data into a

4   plurality of areas S each consisting of M × N ($1 \le M$, N)

5   pixels;

6   a processing part for defining a plurality of areas

7   G each consisting of $P \times Q$ ($1 \leq P, Q$) of the areas S;

8   a processing part for allocating each of the areas S

9   constituting each area G to some one of: areas T_1 - T_n in

10   which said digital watermark information b_1 - b_n is

11   respectively embedded and areas H_1 - H_m ($1 \leq m$) in which

12   information is not embedded;

13   a processing part for locating one or more areas T

14   and one or more areas H in a predetermined arrangement in

15   each area G; and

16   a processing part for locating the plurality of

17   areas G in a predetermined rule.

1   18.   An apparatus for embedding digital watermark

2   information b_1 - b_n ($2 \leq n$) in image data, comprising:

3   a processing part for dividing the image data into a

4   plurality of areas S each consisting of $M \times N$ ($1 \leq M, N$)

5   pixels;

6   a processing part for defining a plurality of areas

7   G each consisting of $P \times Q$ ($1 \leq P, Q$) of the areas S;

8   a processing part for allocating each of the areas S

9   constituting each area G to some one of: areas T_1 - T_n in

10   which said digital watermark information b_1 - b_n is

11   respectively embedded, areas J_1 - J_k ($1 \leq k$) in which

12   information p_1 - p_k ($1 \leq k$) specifying an embedding format

13   for embedding said digital watermark information b_1 - b_n in

14   said areas T_1 - T_n, and areas H_1 - H_m ($1 \leq m$) in which

15   information is not embedded;

16   a processing part for locating one or more areas T,

17   one or more areas J, and one or more areas H in a

18   predetermined arrangement in each area G; and

19   a processing part for locating the plurality of

20   areas G in a predetermined rule.

1   19.   The apparatus for embedding digital watermark

2   information according to Claim 18, further comprising:

3   a processing part for embedding said digital

4   watermark information b_1 - b_n by increasing or decreasing

5   pixel data values in the corresponding areas T_1 - T_n

6   according to a bit value (0, 1) of each bit of the digital

7   watermark information b_1 - b_n; and

8   a processing part for embedding said information p_1

9   - p_k specifying said embedding format such that said

10   information indicates a pattern of respective

11   increasing/decreasing directions in the area T_1 - T_n for a

12   bit value of the digital watermark information, in each

13   area G to which the areas J_1 - J_k embedded with said

14   information p_1 - p_k belong.

1   20.   The apparatus for embedding digital watermark

2   information according to Claim 17, wherein:

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3   each of said areas G includes a plurality of said

4 areas H that have been allocated so as to be asymmetric in

5 vertical and horizontal directions in the area G in

6 question.

1 21.   An apparatus for extracting digital watermark

2 information $b_1 - b_n$ ($2 \leq n$) from image data in which said

3 digital watermark information is embedded, comprising:

4   a processing part for dividing the image data into a

5 plurality of areas S each consisting of M × N ($1 \leq M, N$)

6 pixels;

7   a processing part for detecting areas $H_1 - H_m$ ($1 \leq$

8 m) in which information is not embedded, from said

9 plurality of areas S; and

10   a processing part for recognizing a plurality of

11 areas G each consisting of P × Q ($1 \leq P, Q$) of the areas S,

12 said plurality of areas G being located on said image data,

13 and said recognition being carried out based on locations

14 of said detected areas $H_1 - H_m$ ($1 \leq m$) on said image data.

1 22.   An apparatus for extracting digital watermark

2 information $b_1 - b_n$ ($2 \leq n$) from image data in which said

3 digital watermark information is embedded, comprising:

4   a processing part dividing the image data into a

5 plurality of areas S each consisting of M × N ($1 \leq M, N$)

6 pixels;

7   a processing part for detecting areas H_1 - H_m ($1 \leq$

8   m) in which information is not embedded, from said

9   plurality of areas S;

10   a processing part for recognizing a plurality of

11   areas G each consisting of P × Q ($1 \leq$ P, Q) of the areas S,

12   said plurality of areas G being located on said image data,

13   and said recognition being carried out based on locations

14   of said detected areas H_1 - H_m ($1 \leq$ m) on said image data;

15   a processing part for extracting, in each of the

16   plurality of areas G recognized, information p_1 - p_k ($1 \leq$ k)

17   from areas J_1 - J_k in which said information p_1 - p_k ($1 \leq$ k)

18   should be embedded, said information p_1 - p_k specifying an

19   embedding format for embedding said digital watermark

20   information b_1 - b_n respectively in said areas T_1 - T_n;

21   a processing part for recognizing the embedding

22   format of the digital watermark information b_1 - b_n in the

23   areas T_1 - T_n in the area G in question; and

24   a processing part for extracting the digital

25   watermark information b_1 - b_n from the areas T_1 - T_n,

26   according to the recognized embedding format.

1   23.   The apparatus for extracting digital watermark

2   information according to Claim 22, further comprising:

3   a processing part for extracting, for each of the

4   plurality of groups G recognized, the information p_1 - p_k

5   embedded in the areas J_1 - J_k, to recognize a pattern of

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6   increasing/decreasing directions of pixel data values for a

7   bit value of the digital watermark information, in the area

8   G in question, and to detect each bit value of the digital

9   watermark information $b_1 - b_n$ embedded in the areas $T_1 - T_n$

10   according to the recognized pattern of

11   increasing/decreasing directions.

1   24.   The apparatus for extracting digital watermark

2   information according to Claim 21, further comprising:

3   a processing part for detecting a plurality of areas

4   H from each of the areas G; and

5   a processing part for comparing the detected areas H

6   with an embedding pattern for the areas H, said embedding

7   pattern being determined in advance such that the areas H

8   become asymmetric in vertical and horizontal directions in

9   the area G in question; and

10   a processing part for judging contents of image

11   processing carried out on the image data.

1   25.   An apparatus for embedding digital watermark

2   information $b_1 - b_n$ ($2 \leq n$) in image data, comprising:

3   a processor; and

4   a storage unit for storing codes for making the

5   processor execute a method of embedding the digital

6   watermark information; wherein:

7   said codes comprises:

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8   codes for dividing the image data into a plurality

9   of areas S each consisting of M × N (1 ≤ M, N) pixels;

10   codes for defining a plurality of areas G each

11   consisting of P × Q (1 ≤ P, Q) of the areas S;

12   codes for allocating each of the areas S

13   constituting each area G to some one of: areas T_1 - T_n in

14   which said digital watermark information b_1 - b_n is

15   respectively embedded, areas J_1 - J_k (1 ≤ k) in which

16   information p_1 - p_k (1 ≤ k) specifying a embedding format

17   for embedding said digital watermark information b_1 - b_n in

18   said areas T_1 - T_n, and areas H_1 - H_m (1 ≤ m) in which

19   information is not embedded;

20   codes for locating one or more areas T, one or more

21   areas J, and one or more areas H in a predetermined

22   arrangement in each area G; and

23   codes for locating the plurality of areas G in a

24   predetermined rule.

1   26.   An apparatus for extracting digital watermark

2   information b_1 - b_n (2 ≤ n) from image data in which said

3   digital watermark information is embedded, comprising:

4   a processor; and

5   a storage unit for storing codes for making the

6   processor execute a method of extracting the digital

7   watermark information; wherein:

8   said codes comprises:

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9   codes for dividing the image data into a plurality

10   of areas S each consisting of $M \times N$ ($1 \leq M, N$) pixels;

11   codes for detecting areas H_1 - H_m ($1 \leq m$) in which

12   information is not embedded, from said plurality of areas

13   S;

14   codes for recognizing a plurality of areas G each

15   consisting of $P \times Q$ ($1 \leq P, Q$) of the areas S, said

16   plurality of areas G being located on said image data, and

17   said recognition being carried out based on locations of

18   said detected areas H_1 - H_m ($1 \leq m$) on said image data; and

19   codes for extracting, in each of the plurality of

20   areas G recognized, information p_1 - p_k ($1 \leq k$) from areas

21   J_1 - J_k in which said information p_1 - p_k ($1 \leq k$) should be

22   embedded, said information p_1 - p_k specifying an embedding

23   format for embedding said digital watermark information b_1

24   - b_n respectively in said areas T_1 - T_n.

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